Sediment Quality Assessment Study at the B Street/Downtown Piers, Downtown Anchorage, and Switzer Creek, San Diego

Phase I Results Preliminary Summary

May 13, 2004

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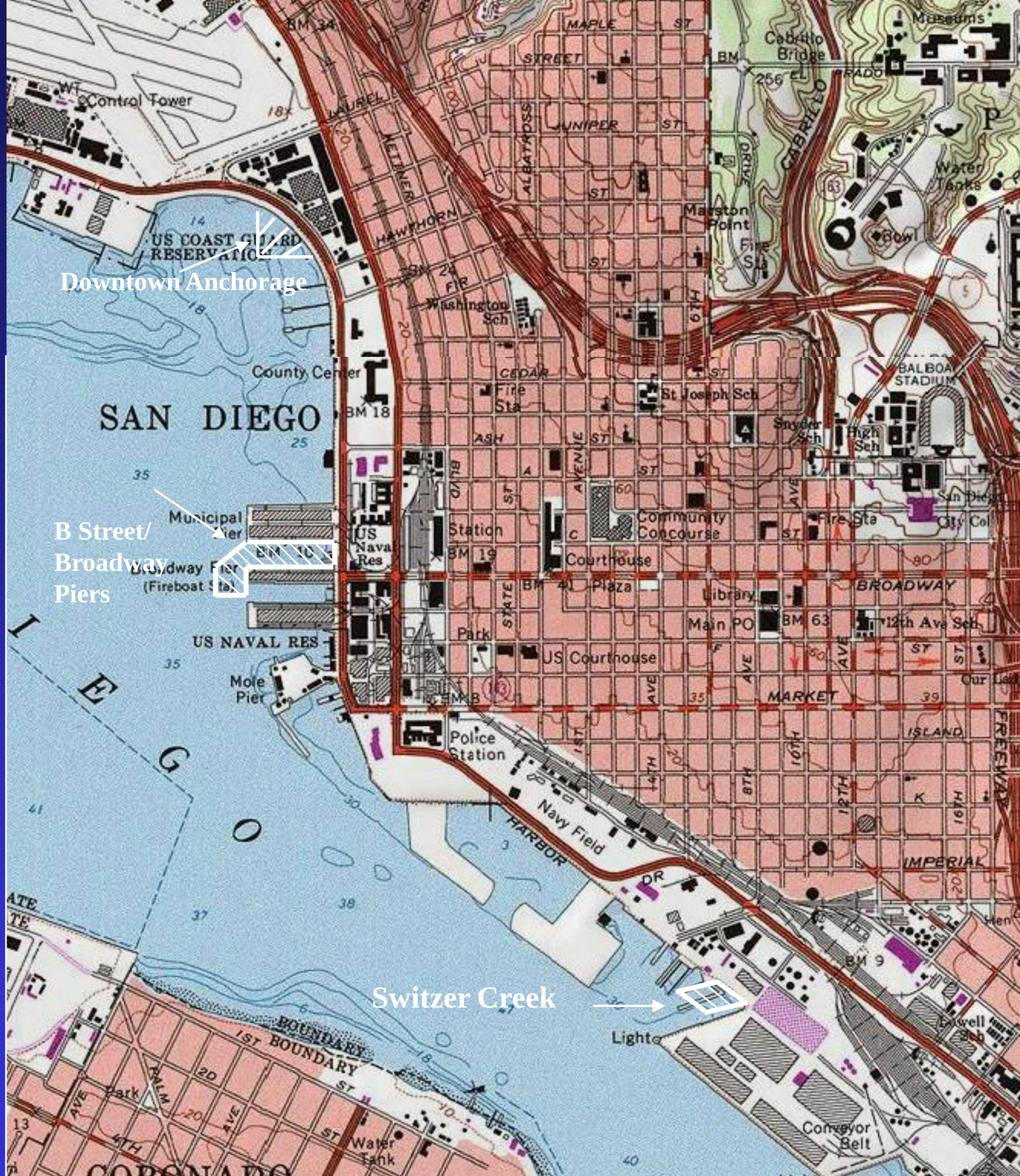
In cooperation with:
San Diego Regional Water Quality Control Board
City of San Diego
Port of San Diego


Downtown Anchorage
B Street/
Broadway
Piers
Switzer Creek
SAN DIEGO
US COAST GUARD
RESERVATION
Control Tower
County Center
Municipal
Pier
US NAVAL RES
Mole
Pier
Police
Station
Navy Field
HARBOR
DR
Light
Conveyor
Belt
BOUNDARY
Park
Water
Tank
Cabrillo
Bridge
Museums
Water
Tanks
Bowl
Marston
Point
Washington
Sch
St Joseph Sch
BALBOA
STADIUM
High
Sch
Community
Concourse
Courthouse
Plaza
Library
Main PO
12th Ave Sch
US Courthouse
Station
BROADWAY
MARKET
ISLAND
IMPERIAL
FREEWAY
CEDAR
ASH
JUNIPER
MAPLE
LAUREL
HAWTHORN
FIR
KETTNER
STATE
Fire
Sta
City Col
Our Lady

Toxic Hotspot Designation:
Bay Protection Toxic Cleanup Program
(Fairey et al. 1996, 1998)

B Street/Downtown Piers:

Benthic community degradation

Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs), copper, chlordane, and chemical mixtures

Downtown Anchorage:

Toxicity

Metal and organochlorine pesticide contamination

Benthic community degradation.

Switzer Creek:

Toxicity

Benthic community degradation

Elevated concentrations of copper, PAHs, chlordane and chemical mixtures

Study Collaborators

State Water Resources Control Board —$→ **Regional Water Board**

Sample Collection – Russell Fairey – Moss Landing Marine Labs

Benthic Community Analyses – Jim Oakden – Moss Landing Marine Labs

Toxicity Testing – Brian Anderson – UC Davis

Port of San Diego – additional $

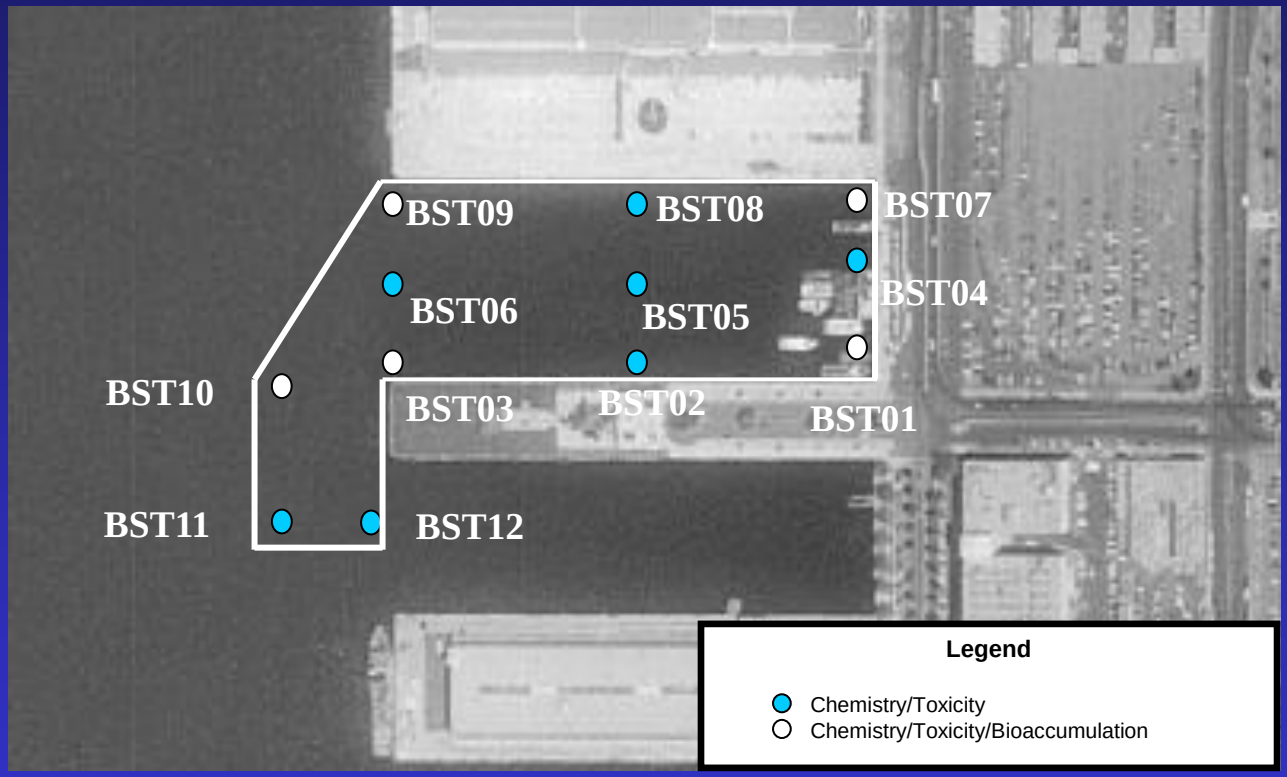
Bulk Phase Chemistry – Rich Gossett – CRG labs

***Macoma nasuta* bioaccumulation exposures – Barry Snyder/Chris Stransky AMEC**

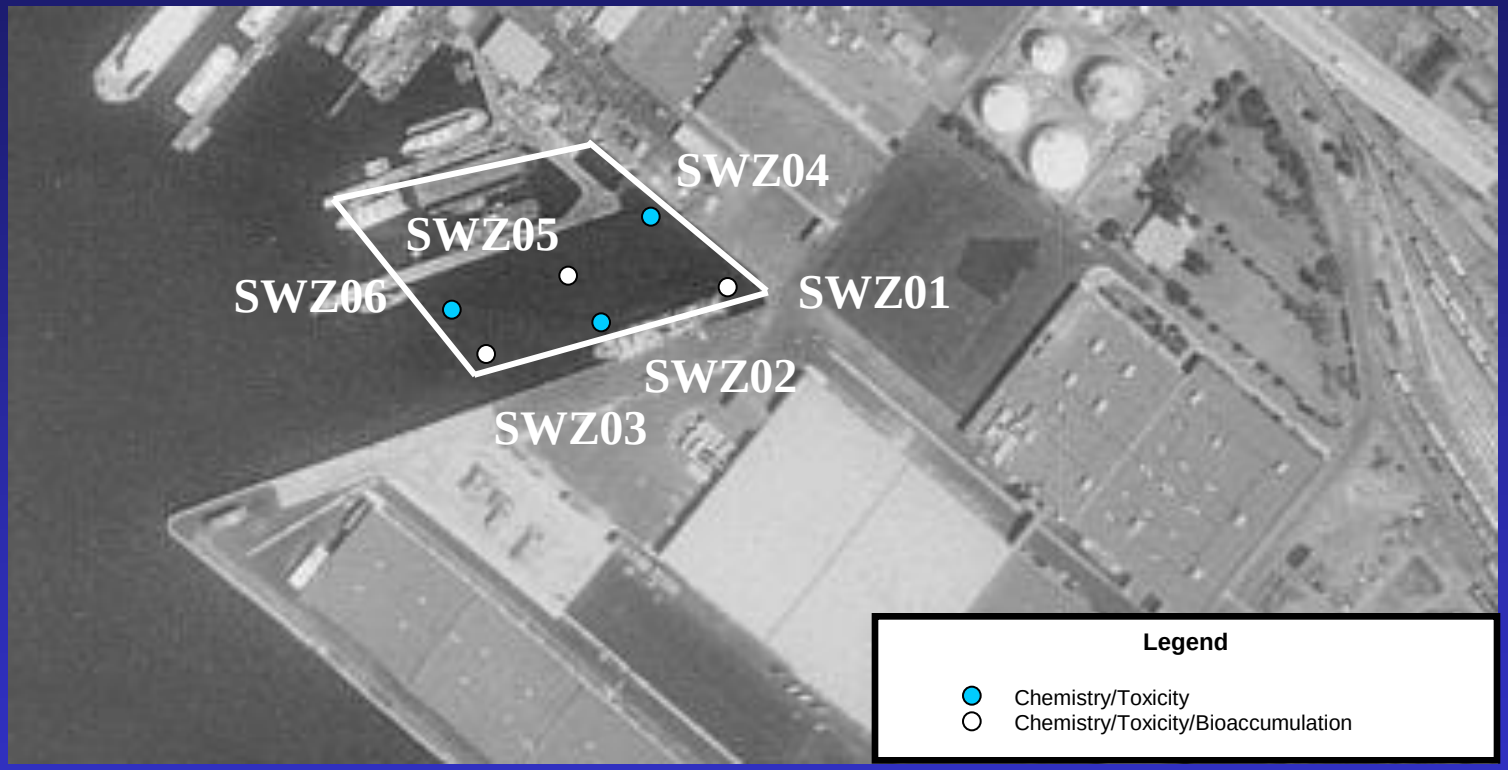
***Macoma nasuta* tissue analyses – Rich Gossett – CRG labs**

Downtown Anchorage stations

B Street/Broadway Piers stations



Switzer Creek stations



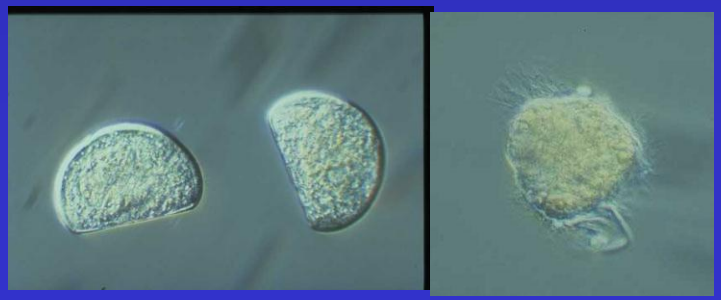
Toxicity Test Results

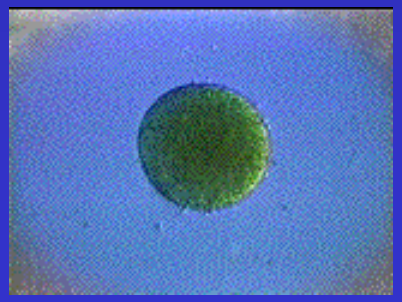
Samples are considered toxic if they meet three criteria:

1. **Significantly different from control (t-test)**

2. **Less than Minimum Significant Difference value (MSD)**

3. **Less than reference site values based on 95% Lower Prediction Limit (LPL)**





Downtown Anchorage toxicity test results

Station#	Amphipod survival	SWI *	Fertiliz.**
DAC01	83%	89%	89%
DAC02	91%	96%	83%
DAC03	90%	90%	75%
DAC04	60%	77%	84%
DAC05	90%	89%	81%
DAC06	96%	100%	83%
DAC07	80%	86%	88%
DAC08	74%	90%	90%
DAC09	88%	79%	84%
Control	98%	85%	74%
95% LPL	85%	45%	57%

* bivalve embryo development, ** 100% PW

B St/Downtown Piers toxicity test results

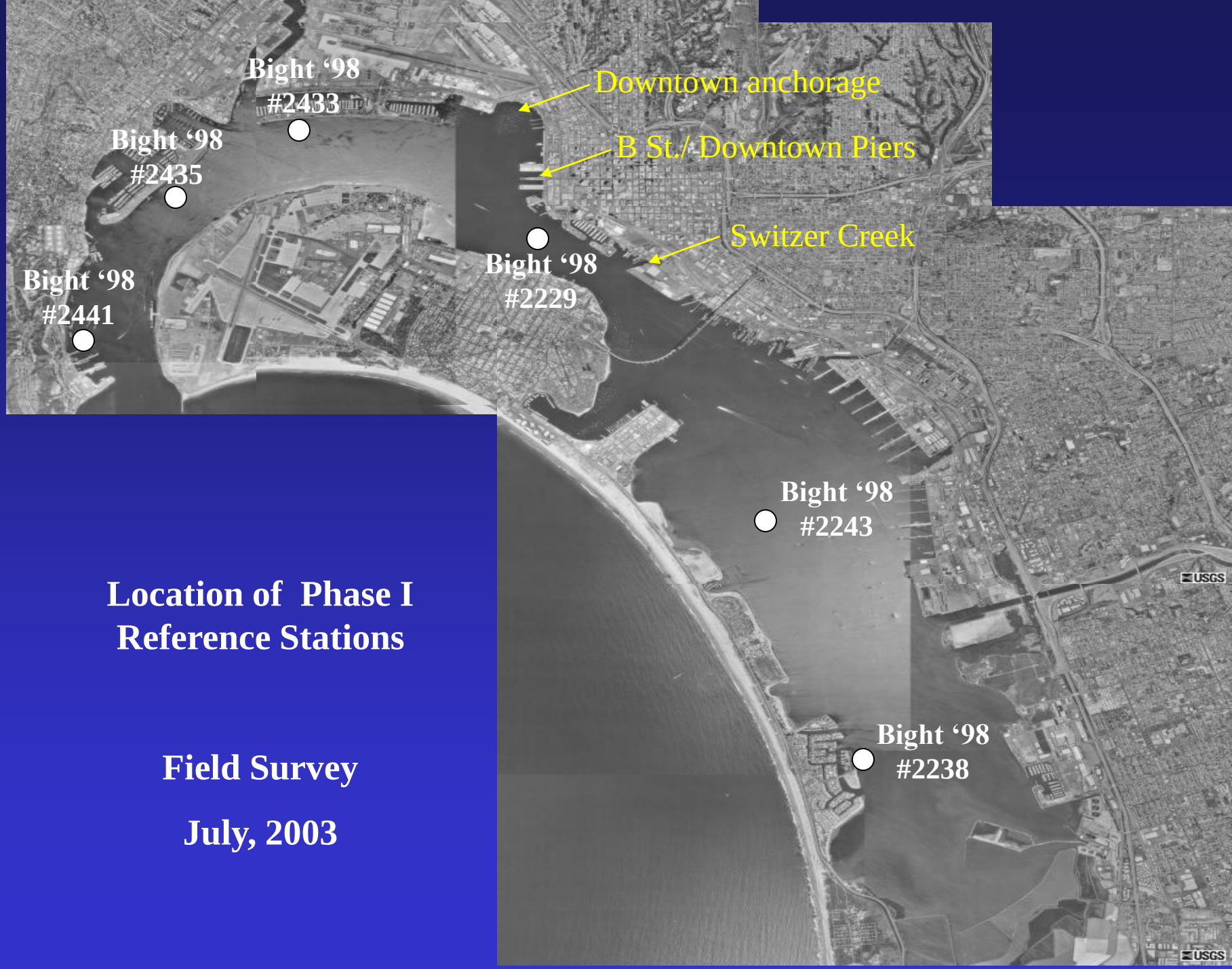
Station#	Amphipod survival	SWI *	Fertiliz.**
BST01	93%	82%	84%
BST02	88%	70%	78%
BST03	89%	79%	85%
BST04	95%	79%	93%
BST05	86%	80%	82%
BST06	96%	90%	90%
BST07	87%	82%	92%
BST08	97%	82%	92%
BST09	90%	79%	88%
BST10	93%	82%	83%
BST11	97%	80%	91%
BST12	95%	76%	54%
Control	98%	85%	74%
95% LPL	85%	45%	57%

* bivalve embryo development, ** 100% PW

Switzer Creek toxicity test results

Station#	Amphipod survival	SWI *	Fertiliz.**
SWZ01	73%	74%	94%
SWZ02	76%	66%	95%
SWZ03	84%	86%	93%
SWZ04	69%	67%	91%
SWZ05	73%	82%	94%
SWZ06	70%	80%	82%
Control	98%	85%	74%
95% LPL	85%	45%	57%

* bivalve embryo development, ** 100% PW



Location of Phase I Reference Stations

Field Survey

July, 2003

Reference station toxicity test results

Station#	Amphipod survival	SWI *	Fertiliz.**
2229	99%	89%	84%
2238	87%	86%	75%
2243	94%	78%	70%
2433	93%	65%	68%
2435	95%	55%	75%
2441	96%	68%	63%
Control	98%	85%	74%

* bivalve embryo development, ** 100% PW

Chemistry Results

Chemical mixtures were compared to a Sediment Quality Guideline Quotient value (SQGQ1)

SQGQ1 comparison to reference stations based on 95% UPL

Individual chemicals were compared to either ERM guidelines or consensus-based guideline values (CBGVs: PAHs & PCBs)

Sediment Quality Guideline Quotient Value

Chemical	Guideline#	Guideline type
Metals (ug/g dry)		
Cadmium	4.21	PEL
Copper	270	ERM
Lead	112.2	PEL
Silver	1.77	PEL
Zinc	410	ERM
Organics (ng/g dry)		
Tot Chlordane*	6	ERM
Dieldrin*	8	ERM
Tot. PAHs (ug/ g oc dry)	1800	Consensus Based
Tot. PCBs*	400	Consensus Based
SQGQ1**	0.218	UPL Reference conditions

** after Fairey et al. 2001

Station	SQGQ1	Guideline values exceeded
2229	0.147	
2238	0.188	
2243	0.135	
2433	0.131	
2435	0.089	
2441	0.166	
DAC01	0.409	* + Hg
DAC02	0.551	* + Hg and PCBs (Q = 1.178)
DAC03	0.618	* + Hg and PCBs (Q = 2.105)
DAC04	0.352	*
DAC05	0.342	*
DAC06	0.288	* + Hg
DAC07	0.283	* + Hg
DAC08	0.223	*
DAC09	0.237	*

* 95% UPL = 0.218

Station	SQGQ1	Guideline values exceeded
SWZ01	0.364	*
SWZ02	0.288	*
SWZ03	0.468	* + PCBs (Q = 1.566)
SWZ04	0.416	*
SWZ05	0.367	* + Chlordane (Q = 2.35)
SWZ06	0.389	* + Chlordane (Q = 2.15)
BST01	0.374	* + Hg
BST02	0.303	* + Hg
BST03	0.221	*
BST04	0.400	* + Hg
BST05	0.226	* + Hg
BST06	0.206	+ Hg
BST07	0.462	* + Hg and PAHs (Q = 1.179)
BST08	0.293	* + Hg
BST09	0.290	* + PAHs (Q = 1.077)
BST10	0.175	
BST11	0.168	
BST12	0.234	* + Hg

Benthic Community Characterization

1. Relative Benthic Index (RBI): used in Bay Protection Toxic Cleanup Program

   Responds to all stressors

   Incorporates 6 metrics : Total No. species, Total No. mollusc species, No. crustacean species, No. crustacean individuals, No. positive indicator species (3), No. negative indicator species (2).

2. Benthic Response Index (BRI)

   Calculated using pollution tolerance values and weighting based on abundance

Downtown Anchorage Benthos

Station	RBI	Assessment	< 95% LPL (0.646)	BRI	Assessment	% Fines	% TOC
DAC01	0.53	T	X	25.8	R	84.3	2.31
DAC02	0.57	T	X	24.5	R	80.1	2.02
DAC03	0.37	T	X	26.6	R	73.7	1.79
DAC04	0.33	T	X	28.4	R	56.0	1.38
DAC05	0.60	U	X	24.6	R	57.4	1.20
DAC06	0.52	T	X	27.2	R	72.0	1.40
DAC07	0.45	T	X	28.9	R	69.0	1.29
DAC08	0.51	T	X	27.1	R	59.4	1.33
DAC09	0.87	U		26.2	R	68.3	1.24

B St/Broadway Piers Benthos

Station	RBI	Assessment	< 95% LPL (0.646)	BRI	Assessment	% Fines	% TOC
BST01	0.71	U		20.3	R	69.8	1.75
BST02	0.57	T	X	19.3	R	69.1	1.25
BST03	0.98	U		19.0	R	62.2	0.91
BST04	0.70	U		16.4	R	68.0	1.92
BST05	0.68	U		23.2	R	64.6	1.01
BST06	0.83	U		13.5	R	61.6	0.76
BST07	0.76	U		23.3	R	70.9	2.09
BST08	0.81	U		21.1	R	67.4	1.17
BST09	0.74	U		14.2	R	54.4	0.72
BST10	0.82	U		20.7	R	56.3	0.68
BST11	0.97	U		11.1	R	59.1	0.70
BST12	0.95	U		16.4	R	66.9	1.00

Switzer Creek Benthos

Station	RBI	Assessment	< 95% LPL (0.646)	BRI	Assessment	% Fines	% TOC
SWZ01	0.11	D	X	28.8	R	96.1	2.06
SWZ02	0.09	D	X	27.9	R	99.8	2.16
SWZ03	0.86	U		27.5	R	92.6	1.40
SWZ04	0.35	T	X	25.0	R	74.7	2.42
SWZ05	0.31	T	X	29.1	R	46.7	1.45
SWZ06	0.46	T	X	24.5	R	57.0	1.90

Reference Station Benthos

Station	RBI	Assessment	< 95% LPL (0.646)	BRI	Assessment	% Fines	% TOC
2229	0.90	U		14.7	R	35.7	0.46
2238	0.76	U		25.4	R	66.5	0.92
2243	0.87	U		22.2	R	42.2	0.39
2433	0.84	U		13.3	R	49.1	0.56
2435	1.11	U		6.9	R	28.1	0.31
2441	0.95	U		14.8	R	62.9	2.00

Macoma 28-d Bioaccumulation Studies

Tissue concentrations at Time 0 compared to tissue concentrations at 28-d to calculate net bioaccumulation

Tissue concentrations after 28-d compared to UPL based on clams exposed to reference sediments

Tissue concentrations were also compared to BTAG Toxicity Reference Values (TRVs) to assess risk to an avian predator, lessor scaup (*Aythya affinis)*

Quality assurance guidelines were met in these analyses, including those for PCB, PAH, and tetrachloro-m-xylene (TCMX) surrogate recoveries.

Macoma Tissue Bioaccumulation Summary

- Metals bioaccumulated in all samples but no metal concentrations exceeded BTAG Toxicity Reference Values (high)
- PAHs bioaccumulated in some samples from B St/Broadway Piers (there are no BTAG TRV values for PAHs)
- No other organic compounds were detected in *Macoma* tissues
- Time 0 lipid (dry wt.) concentration was 1.28%
- The final (28-d) average percent lipid concentrations in clams exposed to site sediments were 0.47%, 2.37%, 1.60%, and 1.15%, in tissue samples from Switzer Creek, Downtown Anchorage, B Street/Broadway Piers, and the reference stations, respectively.
- Time 0 lipid (dry wt.) concentration in *Macoma* used in Chollas/Paleta study was 7.0%

Downtown Anchorage Summary Table

Station	Chemical Contamination		Toxicity	Benthic Community Degradation		Bioaccumulation	
	Sed. guideline exceed	SQGQ > reference		RBI	BRI	1+ analyte > reference	Risk avian receptor
DAC01	Hg	x				x	
DAC02	Hg, PCBs	x				x	
DAC03	Hg, PCBs	x				x	
DAC04		x	Eohaustorius			x	
DAC05		x				x	
DAC06	Hg	x				x	
DAC07	Hg, PAHs	x				x	
DAC08		x				x	
DAC09		x				x	

B St/Broadway Piers Summary Table

Station	Chemical Contamination		Toxicity	Benthic Community Degradation		Bioaccumulation	
	Sed. guideline exceed	SQGQ > reference		RBI	BRI	1+ analyte > reference	Risk avian receptor
BST01	Hg	x				x	
BST02	Hg	x				x	
BST03		x				x	
BST04	Hg	x				x	
BST05	Hg	x				x	
BST06	Hg					x	
BST07	Hg, PAHs	x				x	
BST08	Hg	x				x	
BST09	PAHs	x				x	
BST10						x	
BST11						x	
BST12	Hg	x				x	

Switzer Creek Summary Table

Station	Chemical Contamination		Toxicity	Benthic Community Degradation		Bioaccumulation	
	Sed. guideline exceed	SQGQ > reference		RBI	BRI	1+ analyte > reference	Risk avian receptor
SWZ01	Chlordanes	x		x		x	
SWZ02		x		x		x	
SWZ03	PCBs	x				x	
SWZ04	Hg	x	*Eohaustorius*			x	
SWZ05	Chlordanes	x				x	
SWZ06	Chlordanes, Sb	x	*Eohaustorius*			x	

Weight of Evidence Evaluation for Aquatic Life

Chemistry: 3 categories

Category		Sediment Chemistry LOE Characteristic
Low	○	SQGQ1 < 0.1 or Reference UPL; and 0 chems. > Max (TEL/ERL and Ref. UPL)
Moderate	◎	SQGQ1 ≤ 1.0 and > Ref. UPL; or ≤ 5 chems are > MAX (PEL/ERM and Ref. UPL)
High	●	SQGQ1 > 1.0 and > Ref. UPL; or > 5 chems are > MAX (PEL/ERM and Ref. UPL)

Weight of Evidence Evaluation for Aquatic Life

Chemistry: 3 categories

Category	Toxicity LOE Characteristic
Low ○	All tests > control; OR all tests > reference UPL
Moderate ◎	Amphipod > 50% and < reference UPL and control; OR SWI < reference UPL and control; OR urch. fert.< ref. UPL and control
High ●	Amphipod < 50%, < control, and < reference UPL and; OR Urch. Fert. and SWI < 50%, < control, and < reference UPL; OR Amph and urch fert. < ref. UPL and control; OR Amph and SWI ref. UPL and control

Weight of Evidence Evaluation for Aquatic Life

Benthic Community: 3 categories

Category		Benthic Community LOE Characteristic
Low	○	RBI ≥ 0.60 and reference LPL
Moderate	◎	RBI = 0.31 – 0.59 and reference LPL
High	●	RBI ≤ 0.30 and reference LPL

Aquatic Life Weight of Evidence

- Likely
- Possible
- Unlikely

Aquatic Life Impairment Table			
Chemistry	Toxicity	Benthic Community	Site-specific Impairment from CoPCs
●	●	●	Likely impairment from CoPCs
●	●	⊙	
●	⊙	●	
⊙	●	●	
●	●	○	
●	○	●	
●	⊙	⊙	
⊙	●	⊙	
⊙	⊙	●	
⊙	⊙	⊙	
●	⊙	○	
●	○	⊙	
⊙	●	○	Possible Impairment from CoPCs
⊙	○	●	
⊙	⊙	○	
⊙	○	⊙	
●	○	○	
○	●	●	Unlikely impairment from CoPCs
○	●	⊙	
○	⊙	●	
○	⊙	⊙	
○	○	●	
○	●	○	
○	○	⊙	
○	⊙	○	
⊙	○	○	
○	○	○	

Switzer Creek Aquatic Life Impairment WOE Table

Station	Chemical Contamination	Toxicity	Benthic Community Degradation	Impairment from CoPC?
SWZ01	◎	◎	●	Likely
SWZ02	◎	◎	●	Likely
SWZ03	◎	◎	○	Possible
SWZ04	◎	◎	◎	Likely
SWZ05	◎	◎	◎	Likely
SWZ06	◎	◎	◎	Likely

○ = low ◎ = moderate ● = high

Phase II Studies

Temporal variability at a subset of stations:

Switzer - SWZ 01, SWZ 02, SWZ 04
Downtown Anch. - DAC 02, DAC 03, DAC 04
B Street/Broadway - BST 01, BST 04, BST 07
5 Reference Stations – 2238, 2243, 2433, 2441, 2229

Triad Studies: Toxicity tests, Chemistry, Benthos (spring only) Bioaccumulation

Toxicity Identification Evaluations

Amphipod 10-d solid-phase toxicity tests
Sea Urchin fertilization in porewater